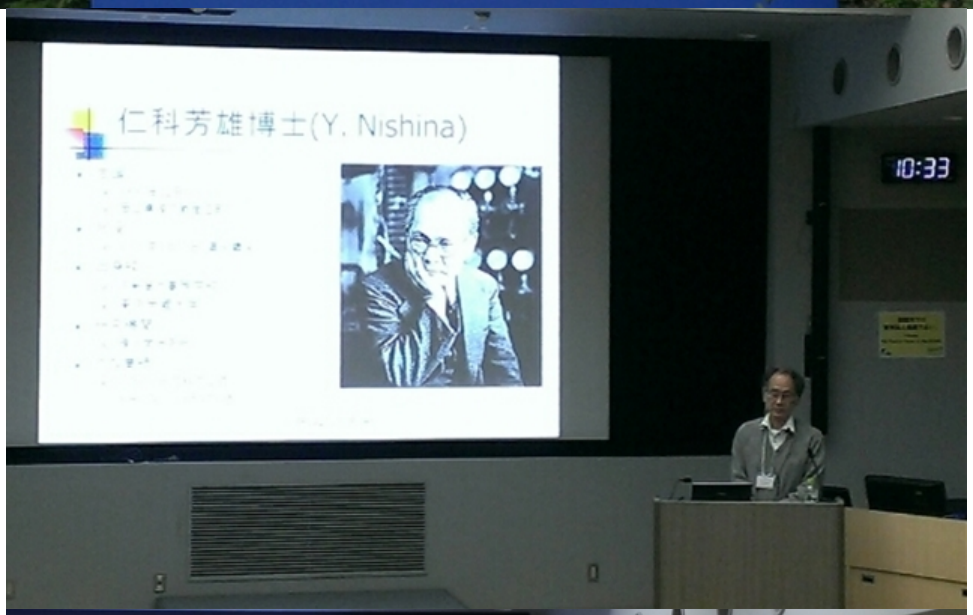
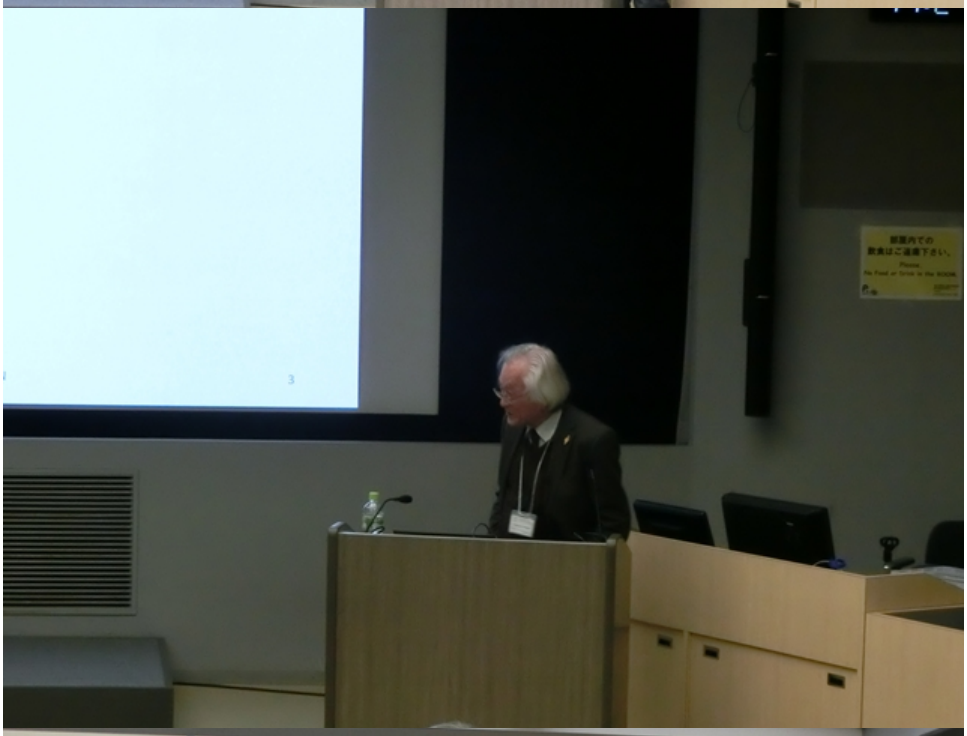
Photo


RIKEN
理化学研究所

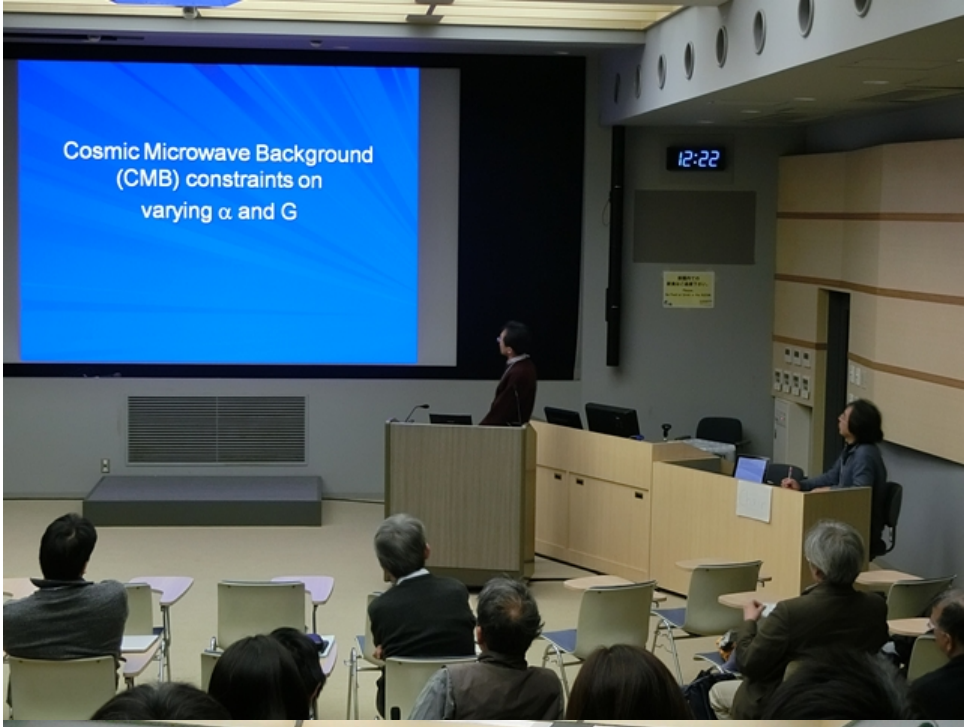

仁科芳雄博士(Y. Nishina)
10:33

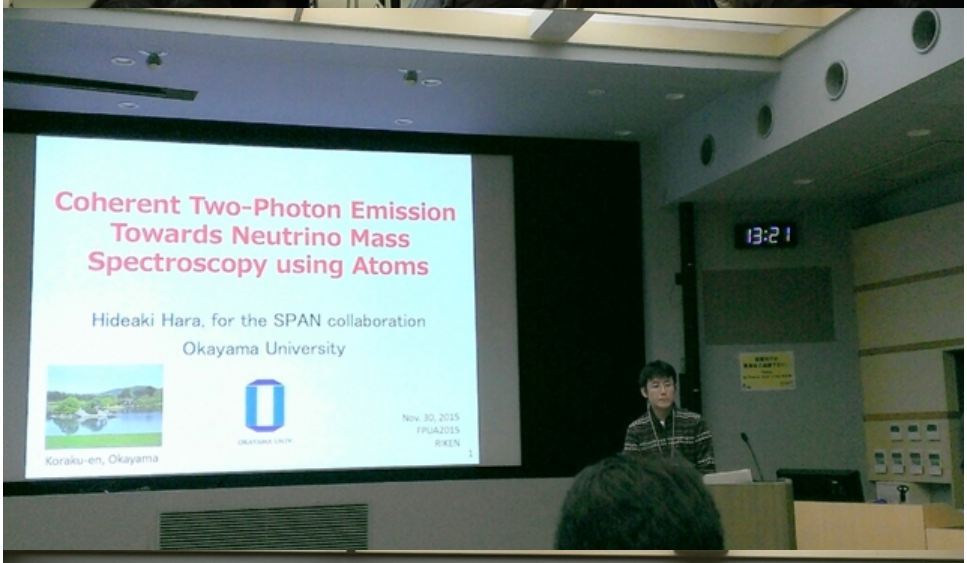

ticle dipole moments
$= -\vec{\mu} \cdot \vec{B} - \vec{d} \cdot \vec{E}$
$\vec{\mu} = \eta \left(\frac{q}{2m}\right) \vec{s}$
CP even
$\vec{d} = \eta \left(\frac{q}{2mc}\right) \vec{s}$
CP odd
10:35

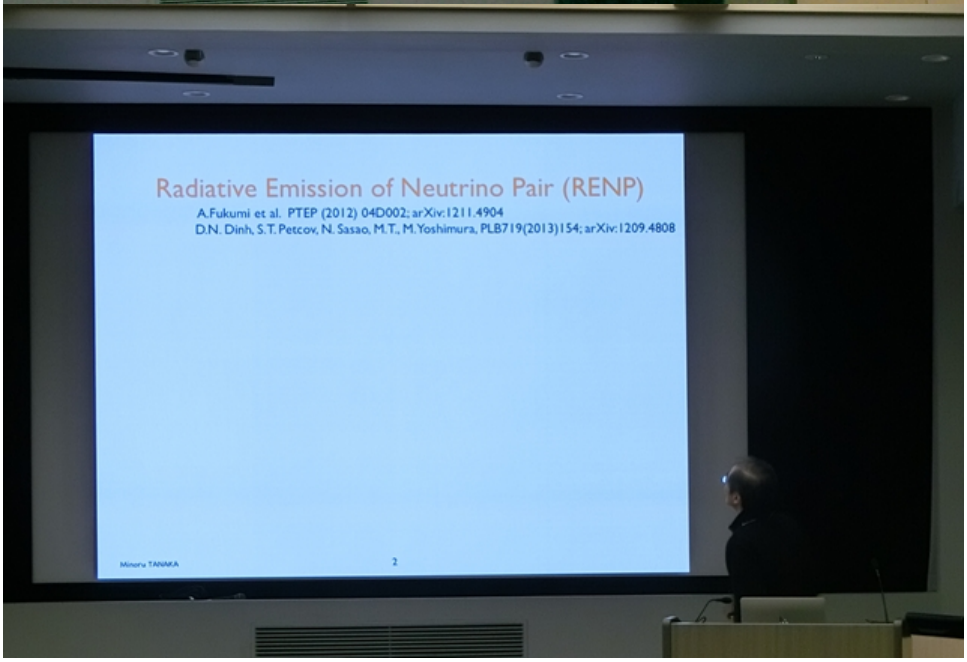

11:03

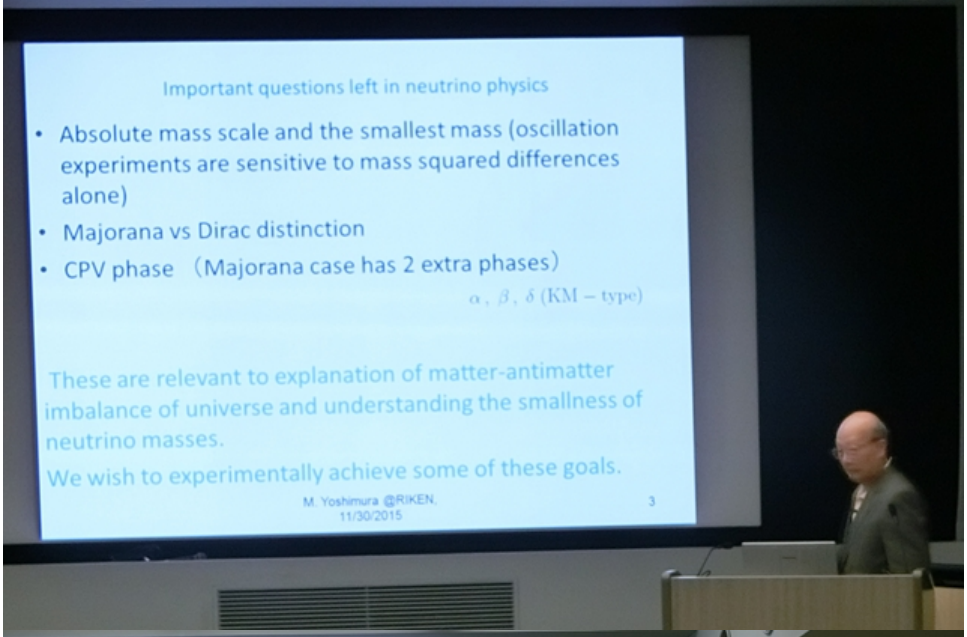


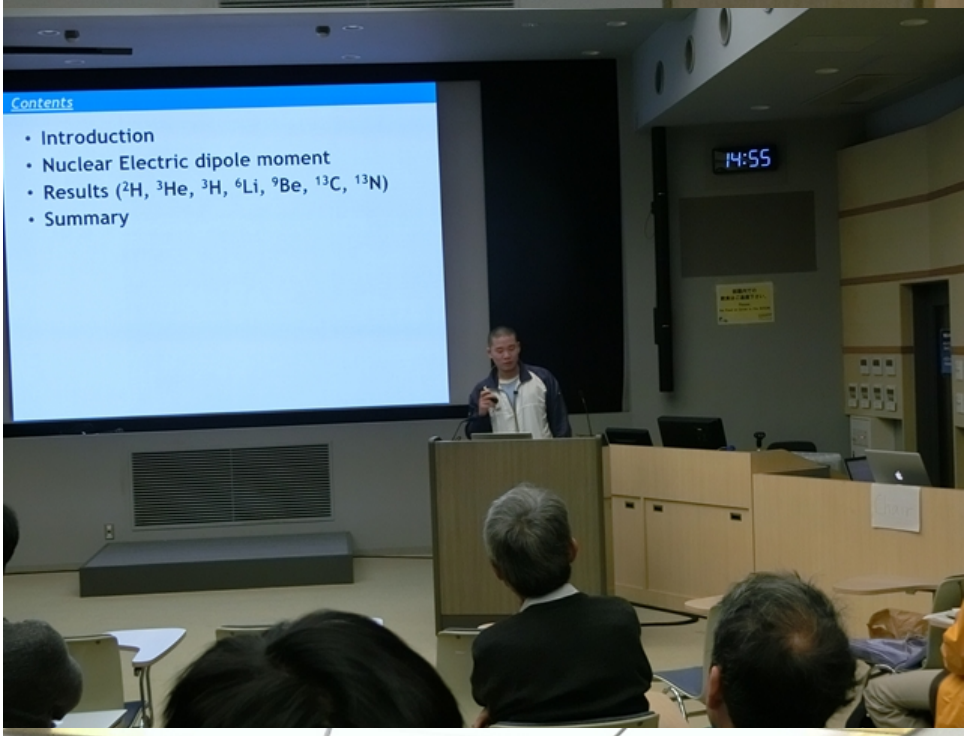

Mu Hyperfine Structure
4463 MHz
11:56

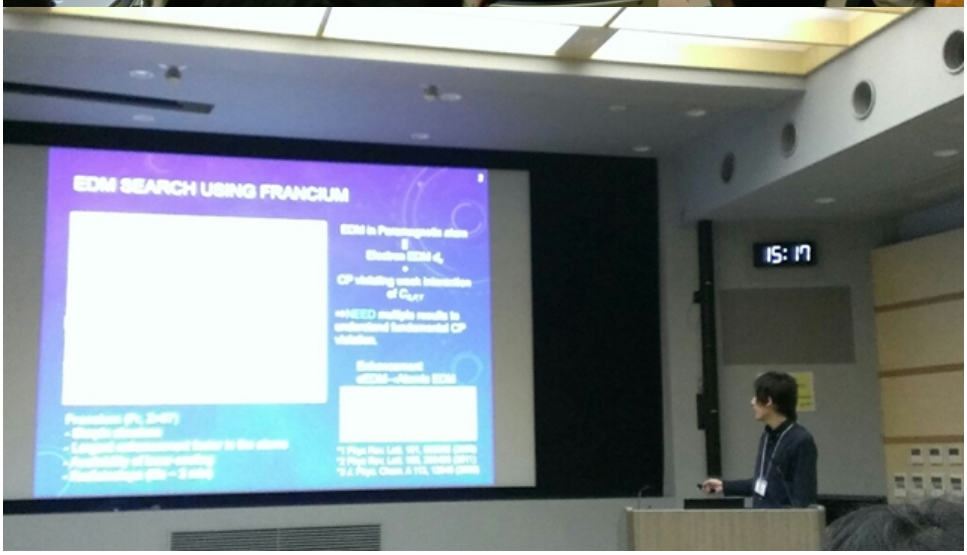

Cosmic Microwave Background
(CMB) constraints on
varying α and G
12:22


Coherent Two-Photon Emission
Towards Neutrino Mass
Spectroscopy using Atoms
Hideaki Hara, for the SPAN collaboration
Okayama University
Koraku-en, Okayama
Nov. 30, 2015
FPUA2015
RIKEN
1
13:21


Radiative Emission of Neutrino Pair (RENP)
A.Fukumi et al. PTEP (2012) 04D002; arXiv:1211.4904
D.N. Dinh, S.T. Petcov, N. Sasao, M.T., M.Yoshimura, PLB719(2013)154; arXiv:1209.4808
Minoru TANAKA
2


Important questions left in neutrino physics
• Absolute mass scale and the smallest mass (oscillation experiments are sensitive to mass squared differences alone)
• Majorana vs Dirac distinction
• CPV phase （Majorana case has 2 extra phases）
α, β, δ (KM – type)
These are relevant to explanation of matter-antimatter imbalance of universe and understanding the smallness of neutrino masses.
We wish to experimentally achieve some of these goals.
M. Yoshimura @RIKEN,
11/30/2015
3

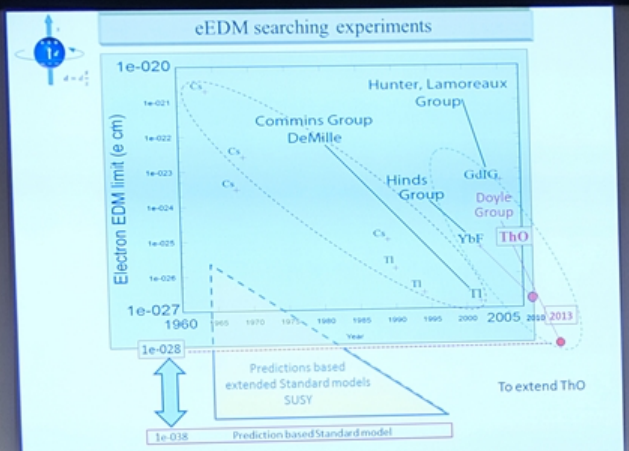

Contents
• Introduction
• Nuclear Electric dipole moment
• Results (^{2}H, ^{3}He, ^{3}H, ^{6}Li, ^{9}Be, ^{13}C, ^{13}N)
• Summary
14:55


EDM SEARCH USING FRANCIUM
15: 17

Outline of the talk

- General features of EDMs and relationship to the Standard Model
- Manifestation of the electron EDM in atomic and molecular EDMs.
- Need for a relativistic many-body theory of atomic and molecular EDMs
- Current status of the search for the electron EDM and implications for the Standard Model.

eEDM searching experiments



Relativistic quantum chemistry

Schrödinger equation (Non relativistic)

$$i\hbar\frac{\partial\psi}{\partial t}=\left(\frac{\hat{p}^2}{2m}+V\right)\psi$$

Applicable to the molecules only containing light atoms

Dirac equation (Relativistic)

$$i\hbar\frac{\partial}{\partial t}\psi=\left(c\alpha\cdot\hat{p}+\beta mc^2\right)\psi$$

Important for the molecules containing heavy atoms

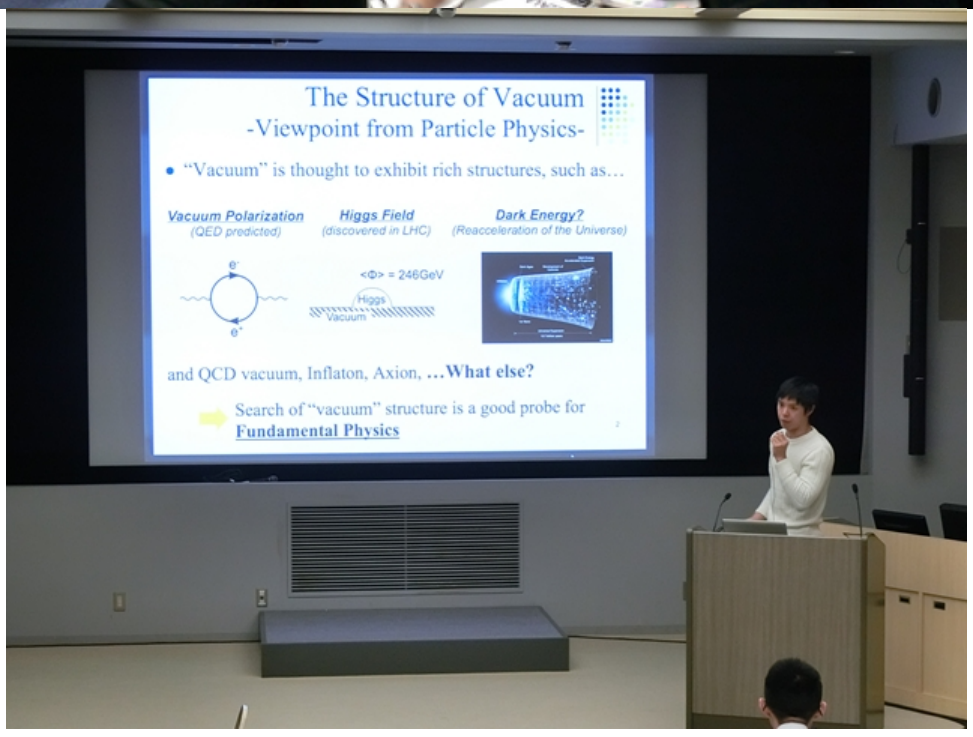
$$\begin{pmatrix} E-mc^2 & 0 & -ic\hbar\frac{\partial}{\partial z} & -ic\hbar\left(\frac{\partial}{\partial x}-i\frac{\partial}{\partial y}\right) \\ 0 & E-mc^2 & -ic\hbar\left(\frac{\partial}{\partial x}+i\frac{\partial}{\partial y}\right) & ic\hbar\frac{\partial}{\partial z} \\ -ic\hbar\frac{\partial}{\partial z} & -ic\hbar\left(\frac{\partial}{\partial x}-i\frac{\partial}{\partial y}\right) & E+mc^2 & 0 \\ -ic\hbar\left(\frac{\partial}{\partial x}+i\frac{\partial}{\partial y}\right) & ic\hbar\frac{\partial}{\partial z} & 0 & E+mc^2 \end{pmatrix}\begin{pmatrix}\varphi_1\\ \varphi_2\\ \varphi_3\\ \varphi_4\end{pmatrix}=\begin{pmatrix}0\\0\\0\\0\end{pmatrix}$$

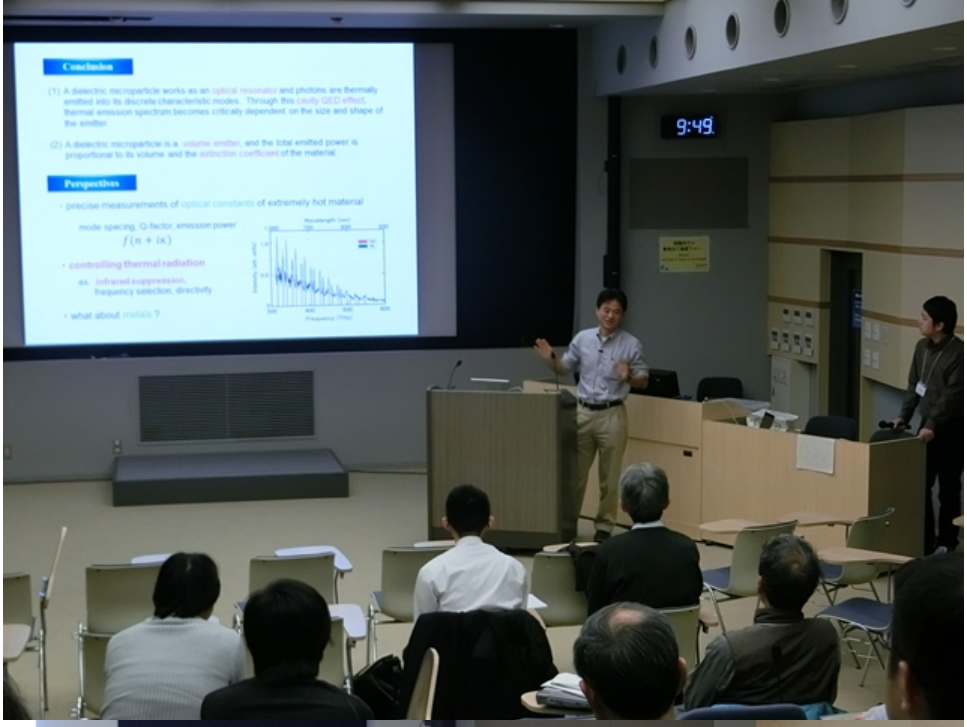
Four components and complicated!

分子を用いたCP対称性破れの検証

常磁性極性分子から検出可能なCP対称性破れ
①電子の電気双極子モーメント(e-EDM)
②スカラー・擬スカラー相互作用(S-PS)


Cold H̄/p̄ experiments at AD, CERN
H̄ 1S-2S transition to test cpt: ALPHA, ATRAP
H̄ GSHF transition to test cpt: ASACUSA, ALPHA
p̄ magnetic moment to test cpt: BASE, ATRAP
p̄/p charge to mass ratio to test cpt & gravitational interaction & sidereal variation: BASE, ATRAP
p̄He spectroscopy to determine p̄ charge and mass: ASACUSA


The Structure of Vacuum
-Viewpoint from Particle Physics-
• "Vacuum" is thought to exhibit rich structures, such as…
Vacuum Polarization
(QED predicted)
Higgs Field
(discovered in LHC)
Dark Energy?
(Reacceleration of the Universe)
e⁻
e⁺
<Φ> = 246GeV
Higgs
Vacuum
and QCD vacuum, Inflaton, Axion, …What else?
Search of "vacuum" structure is a good probe for
Fundamental Physics


Conclusion
(1) A dielectric microparticle works as an optical resonator and photons are thermally emitted into its discrete characteristic modes. Through this cavity QED effect, thermal emission spectrum becomes critically dependent on the size and shape of the emitter.
(2) A dielectric microparticle is a volume emitter, and the total emitted power is proportional to its volume and the extinction coefficient of the material.
Perspectives
- precise measurements of optical constants of extremely hot material
mode spacing, Q-factor, emission power
$f(n+ik)$
- controlling thermal radiation
ex. Infrared suppression,
frequency selection, directivity
- what about metals ?
9:49


部屋内での
飲食はご遠慮下さい。
Please,
No Food or Drink in the ROOM.
Chair

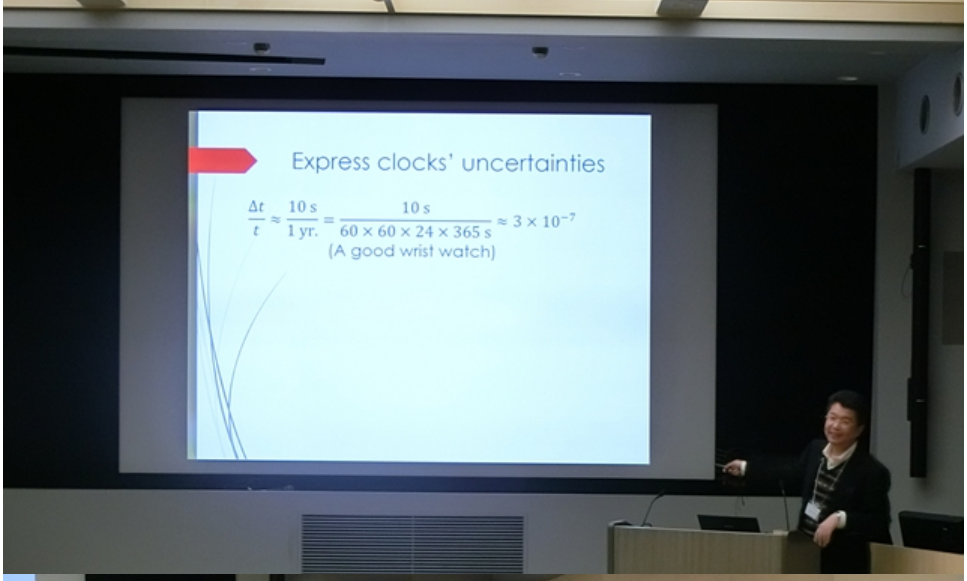

Q(0) transition should be observed by Raman transition
Stark is eliminated
Stark shift
Laser 0
frequency: f_0
Power density: I_0
Laser 1
frequency: f_1 ($\neq f_0$)
Power density: I_1
$X^2\Sigma(v,N) = (0,0)$
$X^2\Sigma(v,N) = (1,0)$
10:47


Electric Dipole Moments of the Closed-shell Atoms
11:32

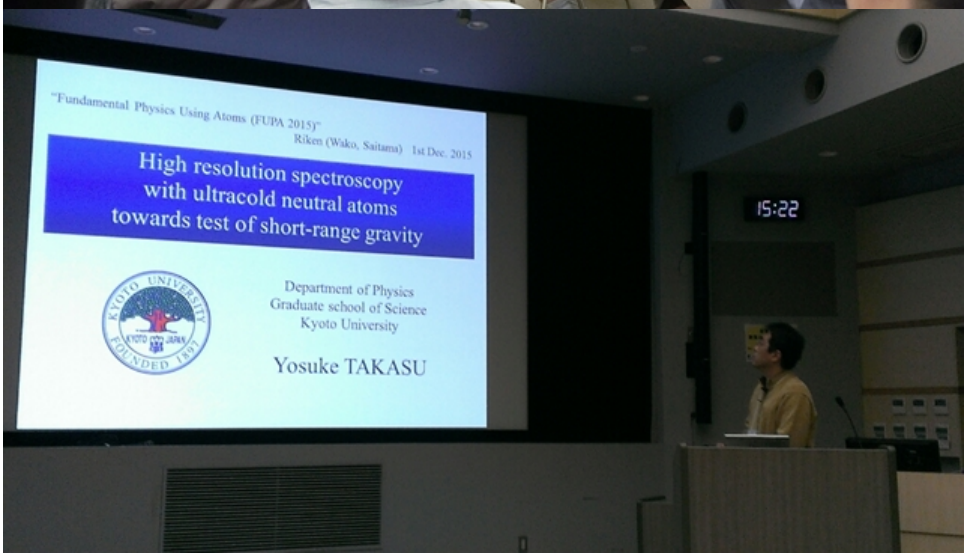

External-feedback
spin maser
Thus, a spin maser of the I = 3/2 spin of 131Xe atom
should work!
11:29


Schiff moments of Xe isotopes
N. Yoshinaga
E. Teruya
K. Higashiyama


Physics explored by cryogenic electrostatic ion storage ring
Toshiyuki Azuma
AMO Physics Lab., RIKEN
Dept. of Physics, Tokyo Metropolitan Univ.
RIKEN


Express clocks' uncertainties
$\frac{\Delta t}{t} \approx \frac{10\,\mathrm{s}}{1\,\mathrm{yr.}} = \frac{10\,\mathrm{s}}{60 \times 60 \times 24 \times 365\,\mathrm{s}} \approx 3 \times 10^{-7}$
(A good wrist watch)


14:50


"Fundamental Physics Using Atoms (FUPA 2015)"
Riken (Wako, Saitama) 1st Dec. 2015
High resolution spectroscopy
with ultracold neutral atoms
towards test of short-range gravity
KYOTO UNIVERSITY
FOUNDED 1897
Department of Physics
Graduate school of Science
Kyoto University
Yosuke TAKASU
15:22


Development of single Yb+ and Ba+ optical clocks and frequency combs towards search for temporal variation of the fine structure constant
December 1, 2015
15:47


Summary
We propose a new scheme to cool Ps down for BEC with 2 steps:
1. Down to ~300K: Thermalization with trapping cold cavity of silica
2. Down to ~1K: Laser cooling(optical molasses)
Evaluate the cooling with integrating:
1. Ps – Ps two body scatterings (new with laser cooling)
2. Thermalization
3. Laser cooling effect
BEC transition is possible with the special laser system
Now develop the new system with the state-of-art optics technology:
1. Large frequency manipulation(>10GHz) by broadband EOM
2. Long time duration(>100ns) by adjusting amplification of seed injection laser
16:43


gorous Evaluation of
ient Dipole Moments and
Polarizabilities
deo Sekino
ashi University
Technology
16:49


UNIVERSITÀ DI SIENA
Francium studies at LNL
F. Marsiotti
CN2SM
Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente
Sezione di Fisica


Chirality of a molecule
and its anapole moment: theory
. Nomura (Yukawa Institute, Kyoto U.)
talk at FPUA2015 @ RIKEN, Wako
December 1, 2015
Fukuyama, T. Momose & DN, arXiv:1505.03888 [hep-ph],
appear in Eur. Phys. J. D
YITP
19:40

Last modified:: 2015/12/02 18:14